A.D. 1910. JUNE 15. № 14,455.

...OJCIECHOWSKI'S COMPLETE SPECIFICATION.

Fig. 1.

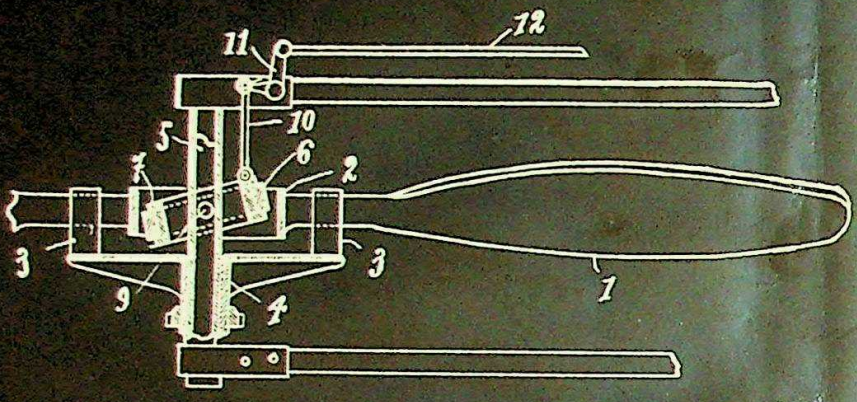


Fig. 2.

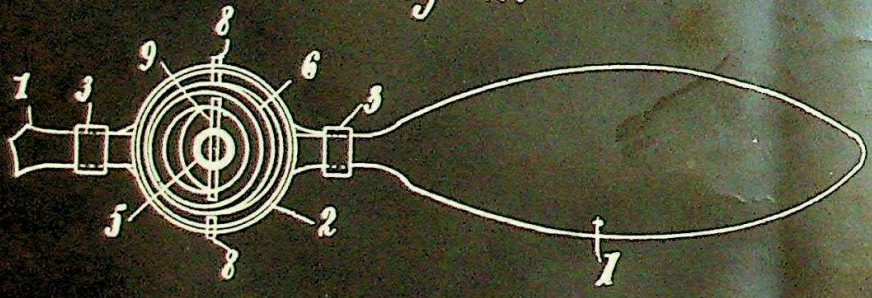


Fig. 3.

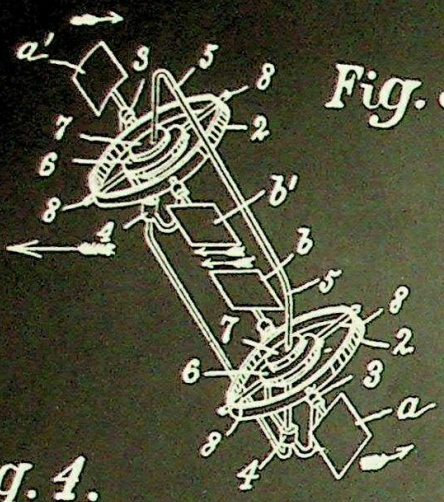


Fig. 4.

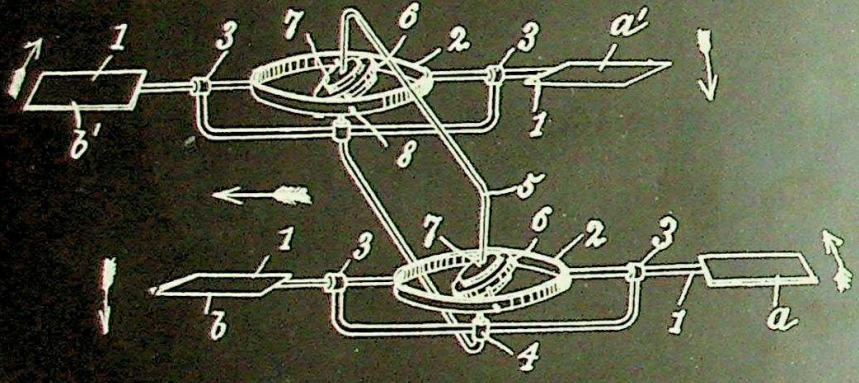


Fig. 5.

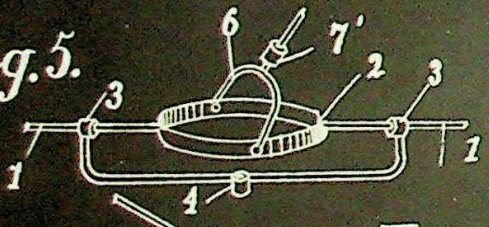
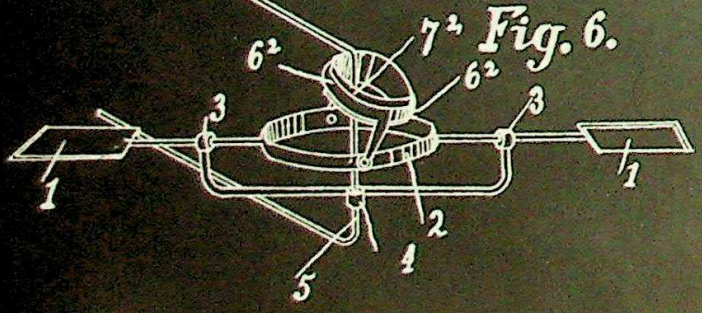


Fig. 6.



Malby & Sons, Photo-Litho.

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COMPLETE SPECIFICATION.

Improvements in Propellers for Aerial Machines.

I, JAKOB WOJCIECHOWSKI, of 101, Leszno, Warsaw, Poland, Russia, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It is well known that one of the main advantages of those aerial machines which are raised by screws, consists in their ability to fly straight up from the starting point, whereas flying machines of the aeroplane type move mainly in a horizontal direction and require a certain space for the start. The main disadvantage of the first named kind of aerial machines lies in the fact that the raising screws cannot be used for propelling in a horizontal direction, and that therefore separate propelling screws have to be employed which of course make the construction and operation of the flying machine very complicated and unreliable. The present invention has for its object to provide a flying machine in which the raising screws are adapted to move the machine in a horizontal direction so that the machine may be driven forwards or backwards and steered by means of the raising screws. For this purpose the raising screws, of which there are at least two, are arranged in such a manner as to be capable of performing an oscillatory movement about their longitudinal axis owing to which movement the inclination of the vane surface of one of the two wings of a screw is made greater than the inclination of the vane surface of the diametrically opposite wing of the screw. The inclination with regard to the horizontal plane of that wing which at a certain moment moves in a direction opposite to the direction of propulsion, is greater than the inclination of the opposite wing which at the same time moves in the direction of propulsion. Each wing performs one complete oscillation during each revolution of the screw, the inclination to the horizontal plane of one wing increasing whilst the inclination of the other wing decreases and *vice versa*. The angle through which the wings oscillate is under easy control of the driver.

In the accompanying drawings

Figure 1 is a side elevation partly in section of a raising screw provided with the arrangement for producing the oscillatory movement thereof,

Figure 2 is a plan view of the same,

Figure 3 is a diagrammatic perspective view of the flying machine showing the position in which the screws are at right angles to the direction of flight,

Figure 4 shows in a similar view the position of the parts when the screws are parallel to the direction of propulsion,

Figures 5 and 6 illustrate modified constructions for producing the oscillatory movement of the screws.

For the purpose of the invention the machine should be provided with at least two screws which are mounted in the frame carrying the operator in such a manner as to rotate in opposite directions. It is preferred to use two independent motors for driving the screws so that in case one of the motors should fail to act, a safe landing may be effected by the aid of the other motor, but both motors may be arranged to operate the two screws simultaneously. The screw propellers are made in the usual manner with two wings arranged diametrically opposite, which wings 1 according to the invention form at their

inner ends a ring 2 and are rotatably mounted in bearings 3 fixed to the hub 4 of the screw. The hub revolves freely on the solid or preferably hollow axle 5 which may be used to connect two parts of the frame as shown. Inside the ring 2 connecting the two wings there is another ring 6 which is adapted to slide in a guide ring 7. If necessary a ball or similar bearing may be interposed between the ring 6 and 7 in order to diminish the friction. The ring 6 is pivotally mounted in the outer ring 2 by means of radial pins 8, whilst the guide ring 7 is in a similar manner mounted in the axle 5 by means of a radial bolt 9. The guide ring 7 can therefore be turned about the pin or bolt 9 so as to assume a slightly inclined position as shown in Figure 1. It is prevented however through its connection with the stationary part 5 to take part in the rotation of the screw. The ring 6 however, owing to its connection with ring 2 through the pins 8, is compelled to participate in the rotation of the screw, being at the same time held by the guide ring 7 at the desired angle of inclination to the horizontal plane into which the guide ring is moved by the operator. The guide ring 7 is kept horizontally or set to any desired angle by means of levers and rods 10, 11, 12, or any other suitable mechanism. The connection of the screw with the guide ring 7 is therefore similar to that used in a cardan joint.

The operation of the device is as follows:

When the guide ring 7, and consequently also the ring 6, is kept in a horizontal position, the screw rotates in the usual manner, both wings of the screw having the same inclination in relation to the horizontal plane. In these circumstances the screw exerts only a raising force in the vertical direction. If however the ring 7 be moved by means of the mechanism 10, 11, 12, into an inclined position, as shown in Figure 1, the points of connection of the ring 2 and the ring 6, which are represented by the pins 8, are constrained to assume a varying inclination so as to adapt themselves to the inclined ring 7, and an oscillatory movement is therefore imparted to the wings about their longitudinal axis, each wing swinging during one revolution of the screw first in the one direction and then back.

This is illustrated by Figures 3 and 4 which show the two main positions of the screws during one revolution. When the wings are at right angles to the direction of flight (Figure 3) the vane surfaces of the wings which are moving backwards, *viz.* the wings a and a^1, have been swung in such a manner as to increase their inclination towards the horizontal plane. The wings therefore act like rudders and tend to propel the machine forwards. By the same oscillation of the screw about its longitudinal axis the other two wings b, b^1 which are about to move in the direction of the flight have been turned so as to decrease their inclination towards the horizontal plane so that the resistance which they offer to the forward movement of the machine is reduced to a minimum. As the wings move from the position shown in Figure 3 into that shown in Figure 4, in which latter they are parallel to the direction of flight, they are swung back by the action of the inclined ring 7 so as to resume their normal inclinations towards the horizontal plane. In this position the wings exert only their normal lifting power upon the machine.

During the continued rotation the wings again assume the inclined positions shown in Figure 3, the inclination of those wings which move in the direction opposite to that of the flight being increased, whilst the inclination of the wings moving in the direction of the flight is at the same time decreased. The angle of the oscillation is dependent on the angle to which the ring 7 has been set by the operator. If the ring be set in the direction opposite to that shown in Figure 1, the rudder-like propelling action of the wings in the horizontal direction will be in the reverse sense, although the direction of rotation of the screws remains the same. The flying machine will therefore be propelled backwards. If the guide ring of one screw be set at an angle different from the angle of the guide ring of the other screw, the steering or horizontal propel-

ling action of one screw will be stronger than that of the other screw and the ship will be turned to the left or right hand, as the case may be. If the guide rings are moved back to the horizontal position, a pure lifting force is exerted by both screws.

Figure 5 illustrates another construction of the device for imparting an oscillatory movement to the wings. The ring 6 of the previous construction is here replaced by a fork 6^1 hinged to the ring 2 and adapted to turn in a socket 7^1 which is set by the operator by means of a suitable gear.

Figure 6 shows a further modification of the device for turning the screw about its axis. The fork 6^1 is substituted by a ring 6^2 hinged to the ring 2 and guided within a second ring 7^2 connected to the steering gear.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In aerial machines having at least two raising screws rotating in opposite directions, the imparting of an oscillatory movement to the wings of the screws about their own longitudinal axes in such a manner as to increase above the normal the angle of inclination towards the horizontal plane of those wings which move in opposition to the direction of flight, and to decrease under the normal the inclination of the wings which move in the direction of the flight, in order to obtain a propelling or steering action of the raising screws upon the aerial machine in the horizontal direction.

2. In aerial machines of the kind referred to in Claim 1, a constructional form of the device for imparting an oscillatory movement to the wings of the screws, comprising a ring or similar member connecting the inner ends of the wings, which ring is connected by a universal joint with a guide ring 7 or 7^2 or socket 7^1 adapted to be set at an angle to the horizontal plane by the operator.

Dated this 15th day of June, 1910.

S. SOKAL,
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Chartered Patent Agent.

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